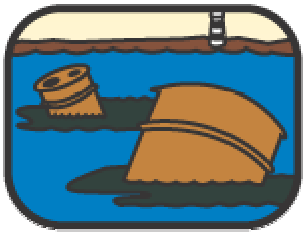

Lessons from the Bay

Types of Pollution

What are the different types of water pollution?

Objectives

Students will

- differentiate between the four types of water pollution (i.e., toxic, sediment, nutrient, and bacterial)
- classify examples of pollution, using a Venn diagram, and graph the number of examples of each type
- infer the effects of certain decisions and actions on the animals and plants of watershed habitats
- learn why there are rules and laws regulating the release of pollution into water
- devise alternatives and solutions to pollution problems.

Background

Pollutants enter the watershed either directly from a traceable source (point source pollution) or through channels that prevent the source from being identified (non-source point pollution). Regardless of the manner in which they enter the water, pollutants can be classified into four types: *toxic*, *sediment*, *nutrient*, and *bacterial*.

Toxic pollution includes chemicals that poison and kill organisms in and near streams, rivers, lakes, and the Bay. When a body of water has a high level of toxic pollution, fishing for the purpose of human consumption is banned. Even low levels of toxicity can be lethal when chemicals accumulate in predators that consume large amounts of slightly poisoned organisms. Examples of toxic pollution include pesticides and herbicides; gasoline, oil, and other automotive products; household cleaning products; paints and solvents; battery acid; industrial waste chemicals; and toxic substances in car exhaust and solid waste incinerator smoke.

Sediment pollution is dirt, minerals, sand, and silt eroded from the land and washed into the water. It comes from areas where there is inadequate vegetation to slow runoff. Sediment causes several problems for aquatic organisms. First, particles of sediment are suspended in the water. The resulting cloudiness decreases the amount of sunlight that can reach underwater plants that provide food and oxygen for underwater animals. Second, as sediment particles settle, they fill spaces between rocks, destroying the habitat needed by many

Related Standards of Learning

Science:
3.1.j; 3.7.d; 4.1.a; 4.5.f; 4.8.a; 4.8.b; 5.7.e; 5.7.f; 6.5.f; 6.5.g; 6.7.a; 6.7.f
Mathematics:
3.22; 4.20; 5.18; 6.18.a
English:
3.1; 3.2; 3.4; 3.8; 3.10; 3.11; 4.1; 4.2; 4.3; 4.7.a; 4.7.b; 4.7.c; 4.7.d; 4.7.e; 5.1; 5.7; 5.8; 6.2; 6.5; 6.6
History and Social Science:
3.9; 3.10; VS.1.b; VS.1.d; VS.1.h; VS.1.i; USI.1.e; USI.1.f; USII.1.f; USII.2.b; USII.8.b

Time Required

Three 45-minute sessions

Materials

- *Pollution Cards, cut apart (handout, page 31)*
- *Pollution Cards Answer Key, for teacher (page 33)*
- *long piece of blue bulletin board paper*
- *4 segments of string tied to create 4 large loops for a Venn Diagram*
- *self-stick notes*

For each group:

- *2 pieces of paper and drawing materials*

underwater insects and other macroinvertebrates. Sediment also clogs the gills of fish, crabs, and other underwater organisms. Sediment can bury fish and insect eggs, preventing them from hatching, and when it covers an oyster bed, it smothers the oysters.

Nutrient pollution results from an overabundance of nutrients such as nitrogen and phosphorus. Living things cannot survive without nutrients, but too much can be detrimental to watershed organisms. An overabundance of nutrients leads to escalation in plant growth, particularly of algae and vascular plants. This causes two problems. First, water clouded with too much alga growth does not allow enough sunlight to reach the plants below. Second, when those plants die, the bacteria that decompose them use inordinate amounts of dissolved oxygen. This deprives underwater animals of the oxygen they need to survive. Sources of nutrient pollution include overflow from sewage treatment plants, leakage from improperly maintained septic systems, discharge from factories, and automobile exhaust. Examples of nutrient pollutants include fertilizers, animal manure, discharge from boat toilets, and household detergents.

Bacterial pollution occurs when there is an excess of harmful bacteria. There are many beneficial bacteria in the water. Even harmful bacteria in small amounts are safe. In larger concentrations, however, certain types of bacteria can be deadly to fish and animals (including humans) that drink or accidentally ingest the water. Certain bacteria can cause illness if they come in contact with an open wound. Interestingly, most of these harmful bacteria do not affect aquatic insects. Some sources of bacterial pollution include overflow from sewage treatment plants, leakage from improperly maintained septic systems, animal manure, and discharge from boat toilets.

Procedures

Session 1 (45 minutes)

Conduct this session in the classroom.

1. Write the four types of pollution on the board. Describe each and explain its negative effects on the Bay watershed (see Background). Write key points on the board, or tell students to take notes: they will need this information to complete the next part of the session.
2. Divide the class into 6 groups. Give each group 2 Pollution Cards, 2 pieces of white construction paper, and some lined paper.
3. Direct each group to read their cards and determine the types of pollution happening in each scenario. Make sure students realize that some illustrate just one type of pollution, while others illustrate more than one.
4. After a significant discussion within the groups, ask students to share their thoughts with the rest of the class. Using the answer key, guide them to add any pollution types they may not have considered.
5. Lay the 4 large loops of string on the floor to create a Venn diagram. Label one circle "sediment," one "toxic," one "nutrient," and one "bacterial." Now have groups place their Pollution Cards in the appropriate section of the diagram. Observe the results, and ask students how many cards describe the cause of only one type of pollution and how many cards describe the cause of more than one type of pollution.
6. Give groups one sticky note for each type of pollution they find on their Pollution Cards, and tell them to label each note with a separate pollution type. For example, if the group has cards 9 and 10, they will need three sticky notes: one for "sediment" on card 9, one for "sediment" on card 10, and one for "toxic" on card 10.
7. On the blackboard, draw the axes of a bar graph, and write the four types of pollution along the x-axis. (See "Preparing Graphs and Charts" on page 69 of the **Project Action Guide**.) Ask students to place their sticky notes in a column above the appropriate pollution type. When all the students have contributed their sticky notes, discuss the graph. Point out that different communities will have varying amounts of these pollution types depending on the choices they make and actions they take.
8. Have students regroup and draw pictures to represent the pollution actions occurring in the Pollution Card scenarios. Each group will draw two pictures: one for each of their cards. Have the groups also write a few sentences describing the pollution, its source, and its effects; have the groups glue the sentences onto their drawings.

Session 2 (45 minutes)

Conduct this session in the classroom.

1. Arrange students into the same groups as in Session 1, and make sure they have their Pollution Cards from the previous session. Tell

them to review their work and discuss solutions to and alternatives for the polluting actions depicted on their cards.

2. Ask each group to share their solutions with the class.
3. As in Session 1, direct the groups to draw pictures illustrating their solutions and alternatives. Tell them to write sentences describing the illustration and glue the sentences onto the drawing.
4. Cut the long piece of blue bulletin board paper in half lengthwise. Fold it "accordion-style" with each folded section large enough for a piece of construction paper to be attached. The blue paper will represent a river flowing into the Chesapeake Bay.
5. Next, staple together the two drawings for each Pollution Card so that the drawing of the problem covers the drawing of the solution/alternative. Staple across the top so that the top drawing can be lifted to reveal the solution/alternative. Then, attach each of the stapled pairs of drawings onto a section of the blue paper (between the folds).
6. Point out to students that the finished construction represents a river flowing to the Bay with many occurrences of pollution along the river's course. Discuss the effects on the Bay of such pollution. Then discuss the possible results if all the solutions and alternatives were put into place.
7. After displaying the "river" on a bulletin board, again fold it "accordion-style," and staple one side to bind it as an oversized book. You may choose to have students make a cover and an "About the Authors" page. Then, allow students to take turns borrowing the book to take home.

Session 3 (45 minutes)

Conduct this session in the schoolyard.

1. Divide the class into groups and have them look for potential pollution problems around the school and in the schoolyard.
2. After students have completed their investigations, discuss their discoveries. Ask students to think of solutions to the pollution problems.
3. Ask students to name other examples of pollution. Discuss community, city, county, state, and federal regulations that serve to limit or prevent pollution. *Why do you think these rules or laws were made? What types of pollution do rules or laws not regulate? Why not?*

Classroom Assessment Suggestions

- *Classification of pollution cards with Venn diagram, and placement of sticky notes to create bar graph*
- *Illustration and description of types of pollution caused by examples on cards, and solutions to the problems*
- *Descriptions of the problems found in the school and schoolyard*

Resources

Allsburg, Chris V. *Just a Dream*. New York: Houghton Mifflin, 1990. ISBN 0395533082.

"Build Your Own Rain Garden." Project Action Guide. *Lessons from the Bay.* 13–17.

Extensions for Students

- *After identifying pollution problems in the school and schoolyard, write the problems on cards, classify them in the Venn diagram as in Session 1, and graph the types to find the most common problems.*
- *Implement some of the school and schoolyard solutions.*
- *Research local and state laws regulating pollution. (See "Using the Library Media Center for Project Research" and "Using the World Wide Web for Project Research" on pages 55–58 of the* ***Project Action Guide****.)*
- *Research water pollution using Morgan's* Acid Rain*, Frost's* Keeping Water Clean*, and other resources (see Resources).*
- *Read Tate's* Crabby's Water Wish*, Allsburg's* Just A Dream*, or Jeffers'* Brother Eagle, Sister Sky*; then write an original story with a message about pollution (see Resources).*
- *Take a field trip to Lake Anna State Park, or another state park, to test water quality, as in the activity "A Check-up for Lake Anna" (see Resources).*
- *See "Build Your Own Rain Garden" on page 13 of the* ***Project Action Guide****.*
- *See "Improving Streams through Waterway Cleanups" on page 33 of the* ***Project Action Guide****.*
- *See "Restoring the Environment through Land Cleanups" on page 29 of the* ***Project Action Guide****.*

"A Check-up for Lake Anna." *Let's Explore and Research Nature (LEARN)*. (Environmental education lesson plans for field trips to Lake Anna State Park. Contact Lake Anna State Park: 540-854-5503.)

Chesapeake Bay Foundation. "Animal Poop: What's the Scoop?," "Driving the Bay to Exhaustion," "Nutrient Nuisance," "Sediment Impediment," "Think, What's Under the Sink?" *Watershed Action for Virginia's Environment (WAVE).* (See <http://www.cbf.org/site/PageServer?pagename=edu_educators_curriculum_va_index>, or contact the Virginia Office: Capitol Place, 1108 E. Main Street, Suite 1600, Richmond, VA 23219; phone 804-780-1392.)

Frost, Helen. *Keeping Water Clean*. Mankato, MN: Capstone Press, 1999. ISBN 0736804080. (See <http://www.capstone-press.com/viewbook.cfm?rid=987>.)

"Improving Streams through Waterway Cleanups." Project Action Guide. *Lessons from the Bay.* 33–38.

Jeffers, Susan. *Brother Eagle, Sister Sky*. New York: Penguin, 1991. ISBN 0803709692.

Morgan, Sally. *Acid Rain*. Earth Watch. New York: Franklin Watts, 1999. ISBN 0531145670.

Poff, Judy A., ed., and George Wills. *A Guide to Virginia's Ground Water.* Virginia Water Resources Research Center. (See <http://www.vwrrc.vt.edu/publications/educatio.htm>.)

"Restoring the Environment through Land Cleanups." Project Action Guide. *Lessons from the Bay*. 29–31.

Tate, Suzanne. *Crabby's Water Wish: A Tale of Saving Sea Life*. Nags Head, NC: Nags Head Art, 1991. ISBN 1878405047.

United States. Dept. of the Interior. U.S. Fish and Wildlife Service. "Nutrient Pollution." Fact sheet. (Contact Chesapeake Bay Estuary Service: 180 Admiral Cochrane Drive, Suite 535, Annapolis MD 21401; phone 310-224-2732.)

"Using the Library Media Center for Project Research." Project Action Guide. *Lessons from the Bay*. 55–56.

"Using the World Wide Web for Project Research." Project Action Guide. *Lessons from the Bay*. 57–58.

"Water Pollution in the Chesapeake Bay." Fact Sheet. Chesapeake Bay Foundation. <http://www.cbf.org/site/PageServer?pagename=resources_facts_water_pollution>.